

REMARKS

Status of Application

Claims 1-10 and 13-15 are pending. Claims 11-12 and 16-105 have been withdrawn as directed to non-elected inventions. These claims have been cancelled without prejudice to their prosecution in other application(s).

Prior Objection and Rejections

In light of applicants' amendments, the objection to the specification and the rejection of claim 13 have been withdrawn. Further, the Examiner indicated that applicants' arguments, filed with respect to the prior rejections of claims 1-10 and 13-15 under Section 102 (b) and 103 (a) have been considered and found persuasive. However, the examiner has made a new ground of rejection in view of 103(a)

Claim Rejections - - 35 U.S.C. § 103 (a)

Claims 1, 5-7, and 10 stand rejected under 35 U.S.C. § 103 (a) as being unpatentable over US 5,733,842 by Gerdes et al, with motivation additionally supplied by US Patent No. 6,802,878 by Monroe. The Examiner states that Gerdes recites a method of preparing a catalyst carrier by providing a mixture of components with at least one modifier selected from alkaline earth silicates and shaping to form an alpha alumina carrier precursor, followed by drying the carrier and calcining the carrier. The Examiner concedes that Gerdes does not claim the impregnation of a preformed alpha-alumina carrier, subjected to calcining. The Examiner states that Gerdes teaches that the catalyst carrier "may comprise a number of other ceramic-forming component, such as titania, and that such a component may be added in the initial mixture or may be added to the porous calcined carrier by impregnation", cited Gerdes at column 5, lines 28-36. The Examiner concludes that it would have been obvious for one of skill in the art at the time the invention was made "to form an alpha-alumina carrier and subsequently impregnate following calcination", in view of the entire teaching of Gerdes. According to the Examiner, the suggestion or motivation is evidenced, both in Gerdes and evidentiary document to Monroe, to use a known technique to yield predictable results with expected success since it is known to add modifiers by

impregnation subsequent to drying and calcining. The Examiner further cites Gerdes as support for the rejection of claims 5, 6, 7, and 10.

Applicants respectfully traverse this rejection. Gerdes does not claim, teach, or suggest the impregnation of a pre-formed alpha alumina carrier with an alkali metal or alkaline metal silicate. The Examiner errs in equating the teachings of Gerdes regarding the modifiers added to the carrier precursor with those modifiers which can be added to the precursor *or* which can be impregnated on the formed carrier. Gerdes teaches that compounds such as calcium or magnesium silicate are used to produce an alpha alumina based catalyst carrier which does not require the presence of pore-inducing burn out materials. The calcium or magnesium silicate are added *to the carrier precursor* (see, e.g., column 4, lines 18-21; lines 59-61; col. 6, lines 42-end, col. 7, lines 1-60, all under “Carrier Preparation” and Examples 1 and 2). The calcium and magnesium silicate can completely replace the need for a ceramic bond component in the precursor mix. Even where a ceramic bond material is still necessary, it is then possible to use ceramic bonds which contain a lower amount of silica than is present in conventional bonds. (col. 5, lines 10-17) The purpose of adding a ceramic bond material to the mixture is to give added strength to the fired carrier. (See col. 5, lines 63-65)

Taking the teachings of Gerdes as a whole, Gerdes first describes at some length the role of calcium or magnesium silicate (col. 5, lines 10-21), followed by a discussion of the role of zirconia (col. 5, lines 22-27), and then finally goes on to state that “The catalyst carrier of the invention may comprise a number of *other* ceramic-forming components chosen *to contribute to physical properties, including crush strength and the like.* (emphasis added) A skilled person would therefore understand that the teachings regarding “other” components would not be applicable to the calcium or magnesium silicates discussed two paragraphs earlier. Further, the teachings regarding titania are quite specific: “For example, components such as titania... are often found to confer particular advantages on such carrier materials. The titania can be added as a component of the initial mixture or it can be added to the porous calcined carrier by impregnation using a titanium salt.” (col. 5, lines 28-31)(emphasis added) Thus, in order to conclude that Gerdes suggests impregnation of calcium or magnesium silicate to a preformed carrier, one of skill in the art would first have to equate calcium or magnesium silicate with “other” ceramic-forming components, and then further read the teaching of the impregnation of titania as suggesting the impregnation of components such as calcium or magnesium silicate.

Further, in contrast to Gerdes' search for materials which can be used to contribute to *physical* properties, the processes of the present invention use modifiers to modify the *chemical* nature of the alpha-alumina surface, in addition to physical properties, if any, which may be affected. The present application teaches:

Further, while not to be constrained by any particular theory, it is believed that during the calcination step of the present invention that the at least one alkali metal silicate and/or at least one alkaline earth metal silicate can react with the alumina surfaces, particularly in instances where there was a relatively high concentration (for example, 2 wt%) of the modifier (that is, at least one alkali metal silicate and/or at least one alkaline earth metal silicate) in the modifier impregnating solution. In the case where alpha-alumina is impregnated with sodium silicate modifier, such reaction is believed to result in the emergence of Na-Al-Si-O compounds in the alumina, for example nepheline (NaAlSiO_4). The presence of nepheline is believed to signify that a reaction as referred to above in this paragraph has occurred, however, it has been found that good performance (that is activity, efficiency and aging) is obtained whether or not nepheline is present in the modified carrier. If the temperature during the calcining carried out subsequent to the impregnation of alpha-alumina with sodium silicate is about 1400 degrees C, there is also formed carnegieite phase.

One of skill in the art would read Gerdes to suggest that *physical properties* would be modified by the use of titania. There is no suggestion in Gerdes that any *chemical properties* of the preformed alpha alumina carrier would be modified. Nor does the citation to the lines in Monroe fill this void. Monroe also teaches that the additions are typically made to alter or otherwise modify the physical properties and/or microstructure of the sintered abrasive particles. (col. 1, lines 36-39) Thus, the Examiner is incorrect to rely upon Gerdes as rendering the claims unpatentable, either alone or in combination with Monroe.

Claims 2-3 and 15 are rejected under 35 U.S.C. § 103 (a) as being unpatentable over Gerdes et al., in view of EP 1086743 by Mikawa et al. The Examiner states that Gerdes' teaching is mentioned above in the 103 rejection. Further, with respect to claims 2-3, the Examiner asserts that Gerdes "further teaches a method of making a porous catalyst carrier comprising the steps of impregnating a preformed alpha-alumina carrier with alkaline earth metal silicate modifier, drying the impregnated carrier, and calcining the dried carrier." The Examiner admits that Gerdes does not teach the selection of the modifier from the group of sodium silicates, lithium silicates and potassium silicates, or mixtures thereof, and furthermore, Gerdes does not teach a sodium silicate modifier with stoichiometry $\text{Na}_2\text{O} \cdot 2.6\text{SiO}_2$. The Examiner finds that Mikawa teaches a method of making a catalyst for the production of epoxides by a vapor phase oxidation of an unsaturated hydrocarbon, where a sodium silicate modifier along with an alpha-alumina carrier is used. The modifier may be

sodium silicate with a stoichiometry of $\text{Na}_2\text{O} \cdot 2.6\text{SiO}_2$. Thus, the Examiner concludes that “it would have been obvious to a person of ordinary skill in the art at the time the invention was made to perform the method of Gerdes using sodium silicates (alkali metal silicates) in place of magnesium and calcium silicates (alkaline metal silicates). The suggestion or motivation for doing so would have been to provide a functional equivalent. With respect to claim 15, the Examiner finds that Gerdes explicitly teaches a method that ends with the calcination of the dried carrier and that Gerdes does not expressly teach that the carrier is washed after calcination. Mikawa teaches washing a modified carrier after calcination. Thus, the Examiner concludes that it would have been obvious to one of skill in the art at the time the invention was made to perform the process set forth by Gerdes including a washing step after calcination. The suggestion or motivation to do so would have been to remove impurities from the carrier.

Applicants respectfully traverse this rejection. Applicants’ comments regarding Gerdes are set forth above. Further, applicants strenuously disagree that “Gerdes teaches a method of making a porous catalyst carrier comprising the steps of impregnating a preformed alpha-alumina carrier with alkaline earth metal silicate modifier, drying the impregnated carrier, and calcining the dried carrier.” As explained above, Gerdes’ teachings are limited to the use of alkaline earth metal silicates as components of the carrier precursor.

Applicants further submit that the use of Mikawa as a prior art reference, alone or in combination with Gerdes, is inappropriate. Mikawa concerns catalysts used in the vapor phase oxidation of unsaturated hydrocarbon having 4 to 20 carbon atoms (Mikawa, paragraph [0001]). Mikawa itself teaches that the catalysts which are used for the production of ethylene oxide, when used in the reaction for producing 3, 4-epoxy-1-butene by the catalytic vapor phase oxidation of 1, 3-butadiene “*generally manifest substantially no catalytic activity, or if catalytically active at all, offer very short service lives as a catalyst*”. (Mikawa, paragraph [0004]) Other references also teach that catalysts used in the epoxidation of ethylene do not have the same effects as catalysts for the epoxidation of olefins having a higher number of carbon atoms. See, e.g., Monnier, The role of Alkali Promoters in the Ag-catalyzed Epoxidation of Olefins, 234th ACS National Meeting, Boston, MA, United States, August 19-23, 2007 (2007) (cesium promoted silver based catalysts used in epoxidation of higher olefins have higher activity, selectivity, and extended catalyst lifetimes, whereas cesium promoted silver based catalyst used to epoxidate ethylene oxide increase selectivity at the expense of activity; rubidium and titanium promoters exhibit

similar behavior similar to cesium for butadiene epoxidation, while potassium promoters have no effect on Ag for butadiene epoxidation); Monnier, et al., Stability and Distribution of Cesium in Cesium Promoted Silver Catalysts used for Butadiene Epoxidation, *Journal of Catalysis* (2004), 226(2), 401-409 (catalysts used for butadiene epoxidation contain much higher levels of cesium promoters (600-1400 ppm) compared to catalysts used for ethylene epoxidation (200-400 ppm)); Monnier, et al., The Direct Epoxidation of Higher Olefins using Molecular Oxygen, *Applied Catalysis, A: General* (2001), 221(1-2), 73-91 (optimum catalyst formulations for propylene or C4 epoxidation are different from those for ethylene epoxidation) .

Even if Mikawa is properly combined with Gerdes, the combination does not render the claims obvious to one of skill in the art at the time the invention was made. Mikawa, et al., like Gerdes, et al., describes in great detail the method of *making the carrier*, by mixing an alpha alumina with a particular sodium content with an aluminum compound, a silicon compound and a sodium compound, followed by calcination of the mixture. Mikawa refers to alpha-alumina powder having micron-scale particle diameters as the sodium containing alpha-alumina used to prepare the carriers. Further the examples in Mikawa, et al. show the use of alpha-alumina having micron-scale particle diameters as a starting material. Other compounds are mixed into the starting material; the mixture is then extruded, dried, calcined, etc. Mikawa, et al. does not describe or suggest treating a *preformed carrier* with a modifier. Thus, even assuming that one of skill in the art would perform the method of Gerdes, et al. using the modifiers of Mikawa et al. (which applicants do not concede), one of skill in the art would still be adding the modifier to the mixture prior to carrier formation—not treating a preformed carrier. The washing step recited by the examiner in Mikawa, et al. is a washing step after formation of the carrier. However, the washing step of Mikawa, et al. is not conducted after treating a *preformed carrier* with a modifier, as set forth in claim 15 of the present application.

The remaining rejections: With regard to claim 14, please see applicants' response regarding the rejection of claims 2-3 above. In addition, for the reasons set forth above, the independent claims are patentable, and the rejections to the dependent claims are moot.

Applicants respectfully requests reconsideration of the rejection of claims 1-10 and 13-15 and further submit that claims 1-10 and 13-15 are in condition for allowance.

Respectfully submitted,

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